DATA SHEET

SKY66425-11 Dual Mode LTE + ISM RF Front-End Module

Applications

- Smart cities with LTE Cat-M
- Smart meters (SM)
- SM communications
- Smart thermostats
- Range extenders

Features

- LTE low- and mid-band transmit and receive pass-through
- 863 to 940 MHz ISM + EU receive LNA/bypass
- Private LTE (Anterix®) 26 dBm transmit capability
- Anterix RX sensitivity boost
- Single-ended, 50 Ω transmit/receive RF interfaces
- Fast turn-on/turn-off time: 1 to 2 µs
- Integrated PA and LNA
- DC blocked on all RF ports
- Supply operation: 2.5 V to 4.8 V
- Sleep mode current: < 1 µA
- Small footprint shielded 64-pin BGA (6 x 7 x 1.14 mm) package, MSL3, 260 °C per JEDEC J-STD-020
- For RoHS and other product compliance information, see the Skyworks Certificate of Conformance.

Description

The SKY66425-11 is a high-performance, highly integrated dual mode RF front-end module for the LTE and Industrial Scientific Medical (ISM) bands.

The SKY66425-11 is designed for ease of use and contains all necessary RF matching and dc biasing circuits. The PA is a two-stage amplifier, capable of over +30 dBm and optimized for power efficiency.

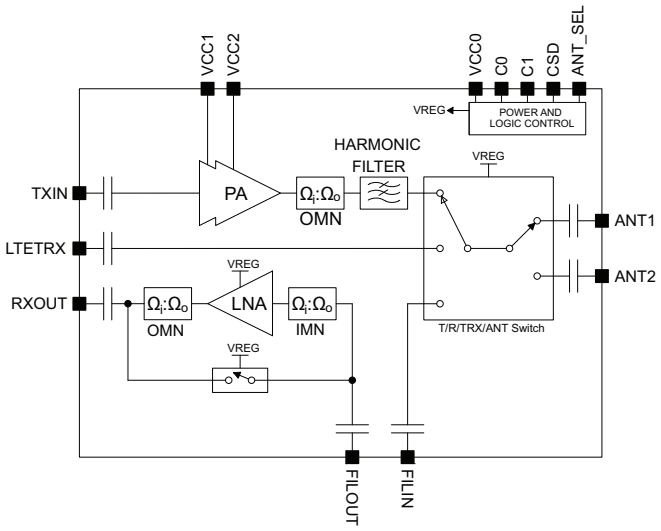


Figure 1. Functional Block Diagram

A functional block diagram of the SKY66425-11 is shown above. The RF blocks operate over a wide supply voltage range, allowing the SKY66425-11 to be used in battery powered applications over a wide spectrum of the battery discharge curve.

The pinout is shown in Figure 2. Signal assignments and descriptions are provided in Table 1.

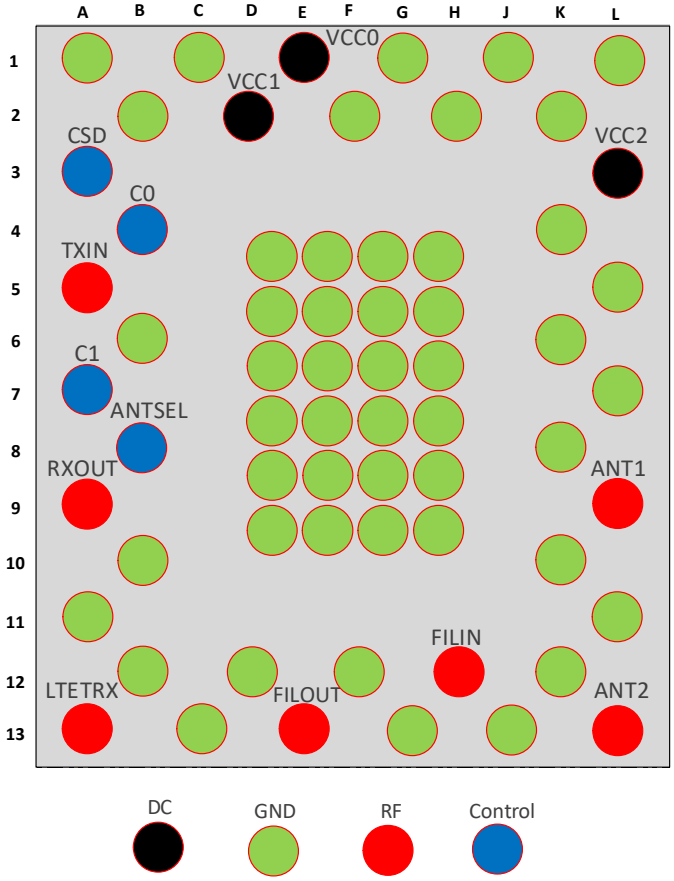


Figure 2. Pinout (Top View)

Table 1. Signal Descriptions[1]

Pad	Name	Description	Pad	Name	Description
A3	CSD	Shutdown control input	D2	VCC1	Stage 1 PA supply
A5	TXIN	Transmit input	E1	VCC0	Logic supply
A7	C1	Mode control input	E13	FILOUT	Connection for output port of an external RX filter (if needed)
A9	RXOUT	Receive output	H12	FILIN	Connection for input port of an external RX filter (if needed)
A13	LTETRX	LTE TRX input/output	L3	VCC2	Stage 2 PA supply
B4	C0	Mode control input	L9	ANT1	Antenna 1 port
B8	ANTSEL	Antenna select control input	L13	ANT2	Antenna 2 port

1. Note: All other pins are ground

Electrical Specifications

Table 2. Absolute Maximum Ratings[1]

Parameter	Symbol	Min	Max	Units
Supply voltage (V_{CC0}, V_{CC1}, V_{CC2})	V_{CC}	–0.3	+5.5	V
Logic control voltage[2]	V_CTRL_MAX	–0.3	+3.6[2]	V
Transmit RF input power (at PA_IN port)	P_{IN_TX}		+10	dBm
Receive RF input power (at ANT1 or ANT2 ports)	P_{IN_RX}		+13	dBm
LTE RF input power (at LTETRX port)			+34	dBm
Thermal resistance	θ_{JC}		16.3	°C/W
Operating case temperature	T_C	–40	+85	°C
Storage temperature	T_{STG}	–40	+150	°C
Electrostatic discharge: Human Body Model (HBM), Class 1C	ESD		1000	V

1. Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their typical value as provided in Tables 3, 4, and 5. Exceeding any of the limits listed here may result in permanent damage to the device.
2. V_{CC} or 3.6 V, whichever is lower.

ESD Handling: *Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.*

Table 3. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Operating temperature	T_C	–40	+25	+85	°C
RF supply voltage[1]	V_{CC0}, V_{CC1}, V_{CC2}	2.5	3.6	4.8	V

1. Power supply pins V_{CC0}, V_{CC1}, V_{CC2} are independent supplies and are not internally tied together.

Table 4. DC[1]

V_{CC0}, V_{CC1}, V_{CC2} = +3.6 V, T_C = +25 °C, P_{IN} = 0 dBm, as measured on the evaluation board de-embedded to device, unless otherwise noted.

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Total supply current in transmit mode	I_{CC_TX29} I_{CC_TX27}[2]	P_{OUT} = +29 dBm, V_{CC1}, V_{CC2} = 3.6 V P_{OUT} = +27 dBm, V_{CC1}, V_{CC2} = 3.6 V		450 360		mA
Quiescent current in transmit mode	I_{CQ_TX}	No RF		50		mA
Total supply current in receive bypass mode	$I_{CC\_RXBYPASS}$			285		µA
Total supply current in LTE TRX mode	$I_{CC\_LTE\_TRX}$			285		µA
Total supply current in sleep mode[3]	I_{CC_OFF}			0.04	1.1	µA
Total supply current in LNA active mode	I_{CC_RX}			4.8		mA

1. Performance is assured only under the conditions listed in this table. Logic levels are compliant with the logic described in Table 7.
2. Not tested in production. Fully characterized and assured by design.
3. All controls must be at 0 V to achieve the specified sleep current.

Table 5. Transmit Mode[1]

V_{CC0}, V_{CC1}, V_{CC2} = +3.6 V, T_C = +25 °C, transmit mode, as measured on the evaluation board, de-embedded to device, all unused ports terminated with 50 Ω, unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		863		940	MHz
Output power (CW)	P_{OUT}	V_{CC1}, V_{CC2} = 4.8 V f = 915 MHz V_{CC1}, V_{CC2} = 4.0 V f = 915 MHz V_{CC1}, V_{CC2} = 3.6 V f = 915 MHz V_{CC1}, V_{CC2} = 3.0 V f = 915 MHz		+31.3 +30 +29.2 +27.7		dBm
Output power (CW)	P_{OUT}	V_{CC1}, V_{CC2} = 3.6V f = 868 MHz		+28.3		dBm
PAE (CW)	PAE	P_{OUT} = +29 dBm, V_{CC1}, V_{CC2} = 3.6 V f = 915 MHz		42.5		%
Saturated gain	$S21_{SAT}$	P_{OUT} = +29 dBm, V_{CC1}, V_{CC2} = 3.6 V f = 915 MHz	26	28.5		dB
Second harmonic (CW)	CW_HD2	P_{OUT} = +29 dBm, V_{CC1}, V_{CC2} = 3.6 V f = 915 MHz		–50	–22	dBc
Third to tenth harmonic (CW)	CW HD3 to HD10	P_{OUT} = +29 dBm, V_{CC1}, V_{CC2} = 3.6 V f = 915 MHz		–76	–72	dBc
Gain variation (CW)	ΔS21	P_{OUT} = +29 dBm, V_{CC1}, V_{CC2} = 3.6 V f = 902 to 931 MHz		0.5	1.2	dBp-p
Small signal gain	S21		26.5	30		dB
Input return loss	S11			–14	–6	dB
Output return loss	$S22_{ANT1/2}$	ANT1/2 ports into 50 Ω		–7	–6	dB
Isolation between ANT1 and ANT2 ports	$ISOL_{ANTSW}$		20	28		dB
Stability[2]	Stab	P_{IN} = +6 dBm, CW f = 0.1 GHz to 20 GHz, load VSWR = 6:1	All non-harmonically related outputs < –42 dBm/MHz			
Ruggedness[2]	RU	P_{IN} = +6 dBm into 50 Ω, CW, load VSWR = 10:1	No permanent damage			

1. Performance is assured only under the conditions listed in this table. Logic levels are compliant with the logic described in Table 10.
2. Not tested in production. Fully characterized and assured by design.

Table 6. Receive Mode[1]

V_{CC0}, V_{CC1}, V_{CC2} = +3.6 V, T_C = +25 °C, receive mode, as measured on the evaluation board, de-embedded to device, all unused ports terminated with 50 Ω, unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		863		940	MHz
Receiver gain	RX_GAIN	At 915 MHz, LNA active		18.7		dB
Receive noise figure	NF	At 915 MHz, LNA active		1.5		dB
Input third order intercept	IIP3	At 915 MHz, LNA active	–6.5	–4.2		dBm
Input 1 dB compression point	IP1dB	At 915 MHz, LNA active	–15	–13.7		dBm
Antenna port return loss	$S11_{ANT}$	At 915 MHz, LNA active		–12	–8	dB
RX port return loss	$S22_{RX}$	At 915 MHz, LNA active		–11	–8	dB
Isolation between external filter pins				40		dB
Receiver gain	RX_GAIN	At 868 MHz V_{CC0} = 3.6 V, LNA active		18.6		dB
Receive noise figure	NF	At 868 MHz V_{CC0} = 3.6 V, LNA active		1.6		dB
Insertion loss in bypass mode	IL_{BYP}	At 915 MHz, LNA bypass		1.4		dB
Antenna port return loss	$S11_{ANT}$	At 915 MHz, LNA bypass		–10		dB
RX port return loss	$S22_{RX}$	At 915 MHz, LNA bypass		–10		dB
Input 1 dB compression point in bypass mode	IP1dB	V_{CC0} = 3.6 V, LNA bypass	10	22		dBm

1. Performance is assured only under the conditions listed in this table. Logic levels are compliant with the logic described in Table 10.

Table 7. LTE TRX Path Mode[1]

V_{CC0}, V_{CC1}, V_{CC2} = +3.6 V, T_C = +25 °C, LTE TRX mode, as measured on the evaluation board, de-embedded to device, all unused ports terminated with 50 Ω, unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Frequency	f		699		2170	MHz
Insertion losses	IL_{LTE}	699 to 960 MHz 960 to 2170 MHz		0.6 0.7		dB
Return loss	RL_{LTE}			–13	–10	dB
Input third order intercept	IIP3	V_{CC0} = 3.6 V		60		dBm
Input second order intercept	IIP2	V_{CC0} = 3.6 V		105		dBm
Input 0.1 dB compression point	IP0.1dB	V_{CC0} = 3.6 V	34	36		dBm
Harmonics level	2f0, 3f0	P_{IN} = 26 dBm V_{CC0} = 3.6 V VSWR = 1:1 VSWR = 5:1		 –74 –64		dBm/MHz
Isolation between ANT1 and ANT2 ports	ISO_{ANTSW}		20	28		dB

1. Performance is assured only under the conditions listed in this table.

Table 8. Timing Characteristics[1]

V_{CC0}, V_{CC1}, V_{CC2} = +3.6 V, T_C = +25 °C, as measured on the evaluation board, de-embedded to device, all unused ports terminated with 50 Ω, unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Turn on	T_{ON}	Sleep to any active mode (LNA bypass, LNA active, LTE TRX, TX PA)		3.6		µs
Turn off	T_{OFF}	Any active mode to sleep		1.1		µs
Mode switch	T_{MODE}	Any active mode to another active mode		1.5		µs
Antenna switch	T_{ANT}	Antenna switch in any active mode		1.6		µs

1. Performance is assured only under the conditions listed in this table.

Table 9. Control Logic Characteristics[1]

T_C = +25 °C as measured on the evaluation board, de-embedded to device, all unused ports terminated with 50 Ω, unless otherwise noted

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Control voltage: High Low	 V_{IH} V_{IL}		 1.6 0		 3.6 0.3	 V V
Input current: High Low	 I_{IH} I_{IL}	V_{IH} = 3.6 V			120	µA

1. Performance is assured only under the conditions listed in this table. Control logic input signals are: CSD, C0, C1 and ANTSEL. Not tested in production. Fully characterized and assured by design.

Table 10. Logic and Mode

Index	Mode	C1	C0	CSD	ANT_SEL
1	Sleep	0	0	0	0
2	LNA bypass to ANT1	0	0	1	1
3	LNA bypass to ANT2	0	0	1	0
4	LNA active to ANT1	0	1	1	1
5	LNA active to ANT2	0	1	1	0
6	LTE TRX to ANT1	1	0	1	1
7	LTE TRX to ANT2	1	0	1	0
8	TX PA to ANT1	1	1	1	1
9	TX PA to ANT2	1	1	1	0

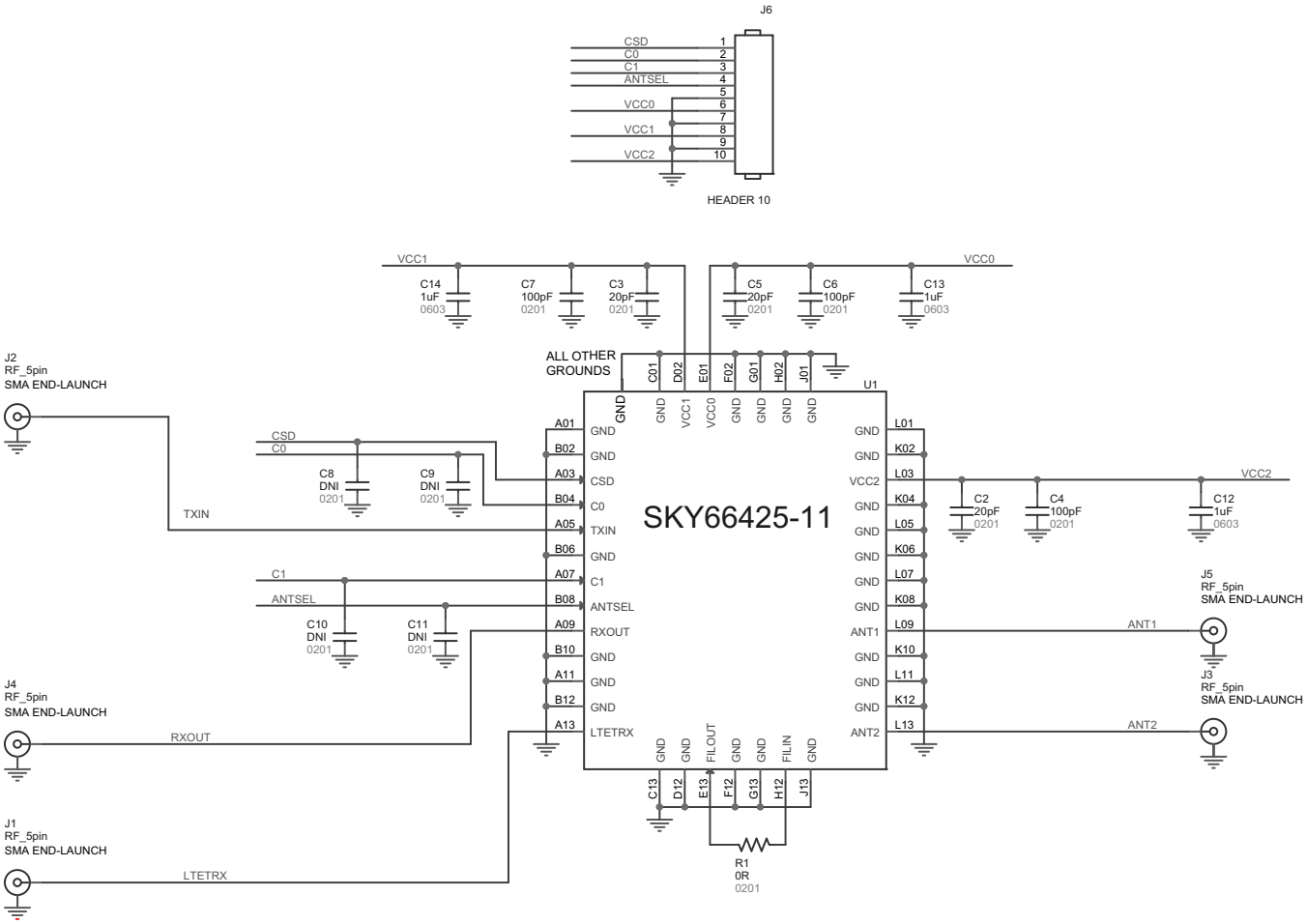


Figure 3. Evaluation Board Schematic

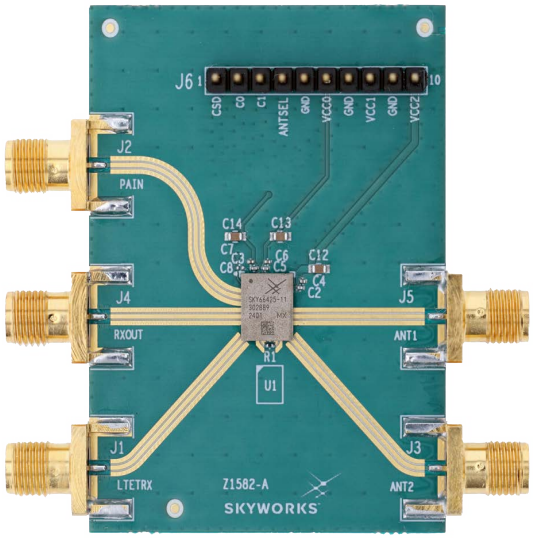


Figure 4. Evaluation Board

Table 11. Evaluation Board Bill of Materials

Reference	Qty	Value	Manufacturer	Part Number	Package	Description
C2, C3, C5	3	20 pF	Murata	GRM0335C1E200JD01	0201	Multilayer ceramic
C4, C6, C7	3	100 pF	Murata	GRM033R71H101KA12	0201	Multilayer ceramic
C8, C9, C10, C11	4	DNI			0201	
C12, C13, C14	3	1 µF	Murata	GRM188R71A105KA61	0603	Multilayer ceramic
J1, J2, J3, J4, J5	5	RF_5pin	SPC/Multicomp	R19_070-18-0032210MM		Connector, SMA end-launch
J6	1	HEADER 10	Samtec	TSW-110-07-G-S	100 mil	1X10 header vertical
PCB1	1	Z1582-A	Skyworks Solutions Inc.	Z1582-A		PCB
R1	1	0R	Panasonic	ERJ1GE0R00	0201	Thick film chip resistor
U1	1	SKY66425-11	Skyworks Solutions Inc.	SKY66425-11		

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY66425-11 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead- or lead-free soldering. For additional information, refer to the Skyworks Application Note, *PCB Design and SMT Assembly/ Rework Guidelines for MCM-L Packages*, document number 101752.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

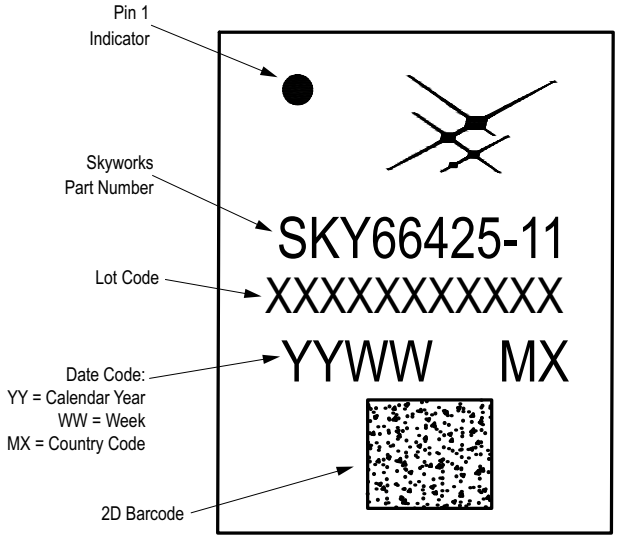
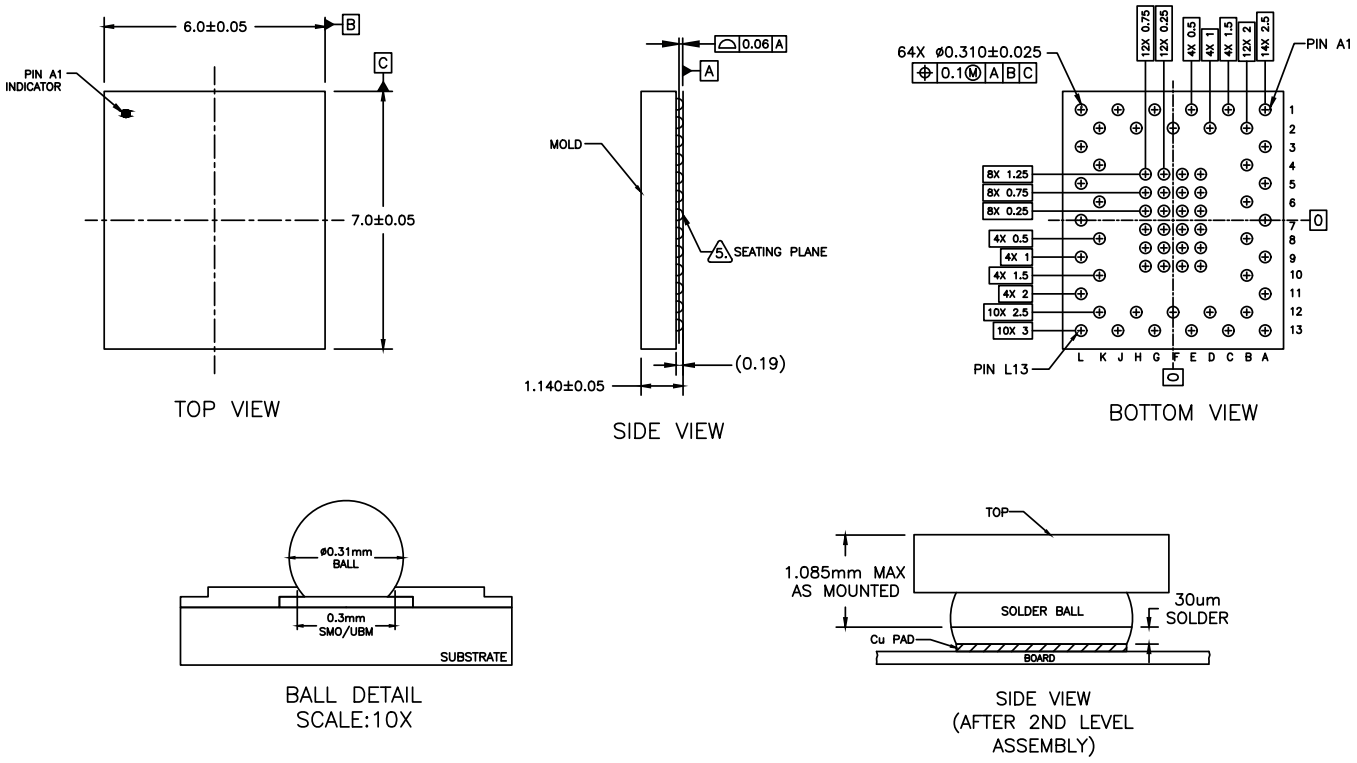


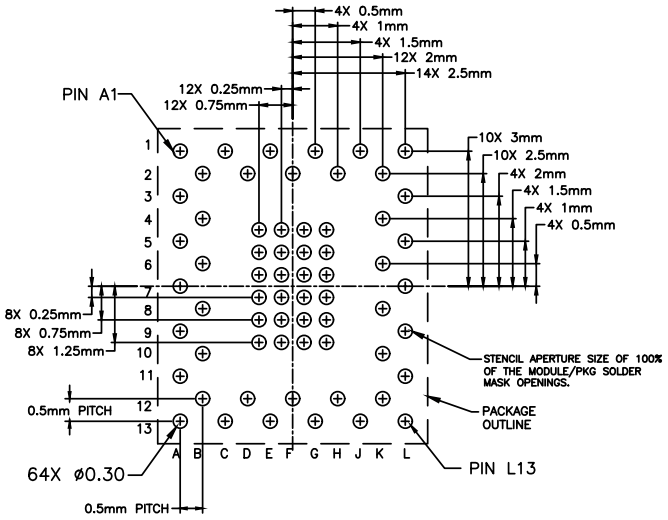
Figure 5. Typical Part Marking



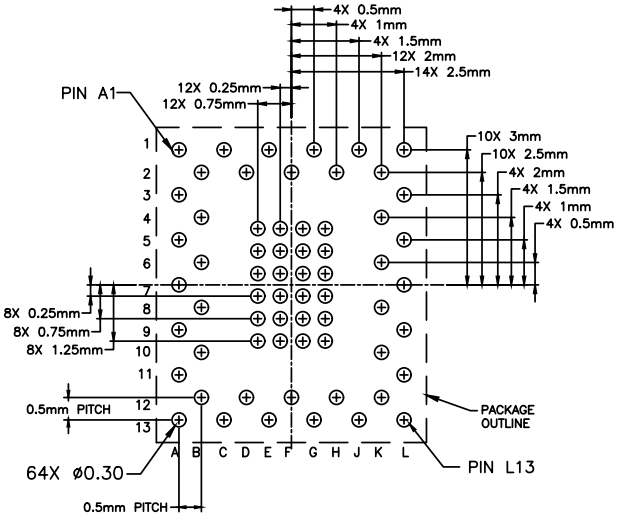
NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONING AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M–1994.
2. DIMENSIONS ARE IN MILLIMETERS
3. PRIMARY DATUM A AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.

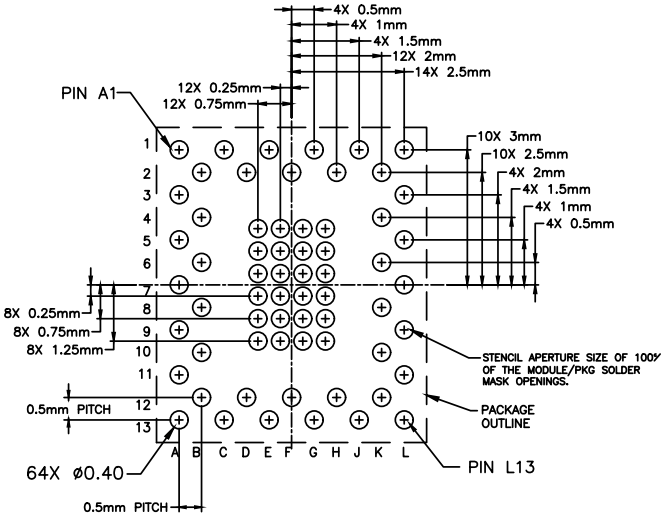
Figure 6. Package Dimensions



STENCIL APERTURE
Top View



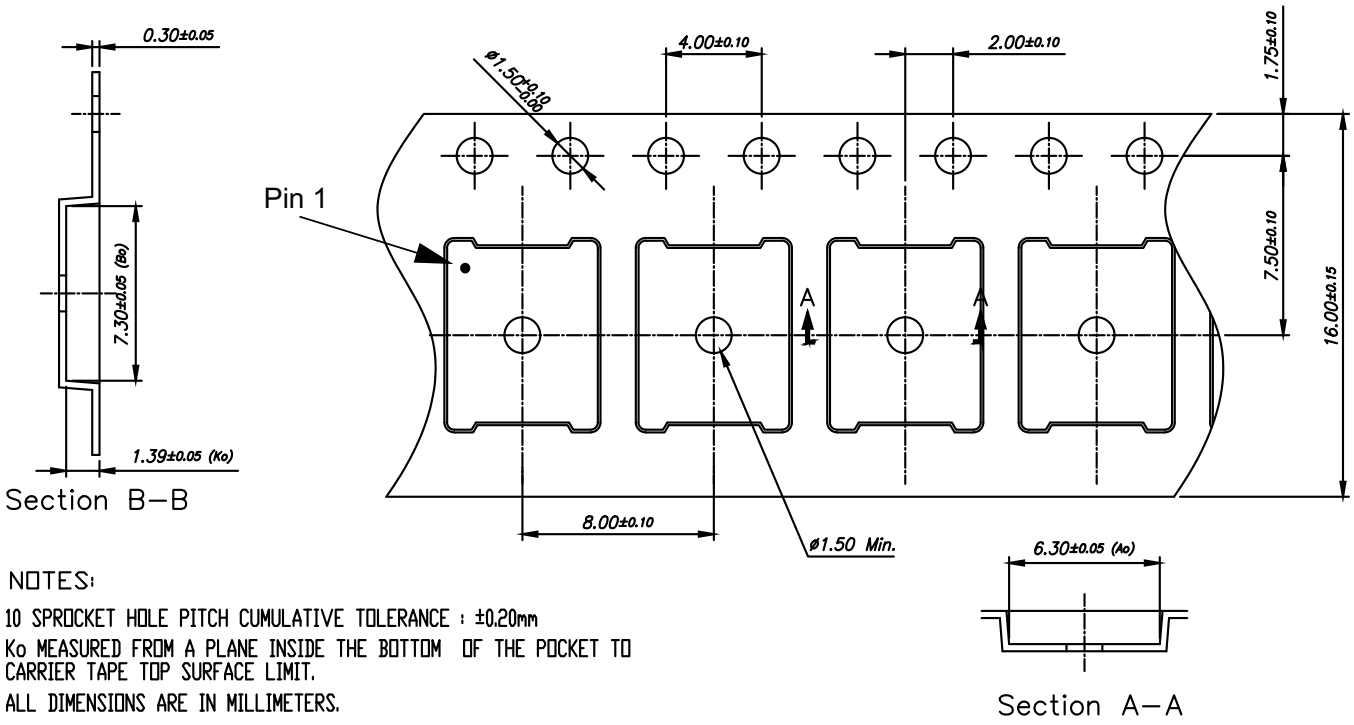
METALLIZATION
Top View



SOLDER MASK OPENING
Top View

NOTE: THERMAL VIAS SHOULD BE RESIN FILLED AND CAPPED IN ACCORDANCE WITH IPC−4761 TYPE VII VIAS. 30−35UM Cu THICKNESS IS RECOMMENDED.

Figure 7. PCB Layout Footprint



NOTES:

10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE : ±0.20mm

Ko MEASURED FROM A PLANE INSIDE THE BOTTOM OF THE POCKET TO CARRIER TAPE TOP SURFACE LIMIT.

ALL DIMENSIONS ARE IN MILLIMETERS.

Figure 8. Tape and Reel Information

Ordering Information

Part Number	Description	Evaluation Board Part Number
SKY66425-11	Dual Mode LTE + ISM RF Front-End Module	SKY66425-11EK1